X-ray Follow-up after Open Reduction Internal Fixation of Distal Forearm Fracture

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Abstract

Background Following surgery, the standard regimen for fractures of the distal forearm includes radiographs taken 2-weeks postoperatively. However, it is unclear whether these radiographs have any therapeutic risks or benefits for patients.

Objective The purpose of this study is to determine the importance of radiographs taken 2-weeks after surgery on distal forearm fractures, especially if it leads to further operations, and to establish whether this practice should be continued.

Materials and Methods This is a retrospective cohort study of patients with a distal forearm fracture treated surgically with a volar locking plate at two university hospitals in Denmark. Standard aftercare at both departments is 2 weeks in a cast. Patients attend a 2-week follow-up, at which the cast is replaced with a removable orthosis and radiographs are taken. It was recorded whether these radiographs had resulted in any change of treatment in terms of further operations, prolonged immobilization, additional clinical follow-up, or additional diagnostic imaging.

Results A total of 613 patients were included in the study. The radiographs led to a change of standard treatment for 3.1% of the patients. A second operation was required by 1.0%; 0.5% were treated with prolonged immobilization, and 1.6% had additional outpatient follow-up due to the findings on the radiographs. Additional diagnostic imaging was performed on 1.9% of the patients.

Conclusion The radiographs taken at the 2-weeks follow-up resulted in a change of treatment in 3.1% of the cases. Given the low cost and minimal risk of radiographs of an extremity, we concluded that the benefits outweigh the costs of routine radiographs taken 2 weeks after surgical treatment of distal forearm fractures.

Keywords
- volar locking plate
- open reduction internal fixation
- follow-up
- distal forearm
- distal radius
- fracture
- X-ray
- radiographs

Fractures of the distal radius are the most common fracture on the upper extremity and represent approximately 9% of all surgically treated fractures.[1,2] Operative treatment with plate fixation is increasing and international guidelines recommend early postoperative follow-up with radiographs.[3,4] The values of these routine radiographs are unclear, as studies of operatively treated distal radius fractures indicate that routine radiographs rarely alter the clinical management regimen.[5] Therefore, this follow-up routine may lead to unnecessary time consumption for both the patient and the health care professional as well as increasing costs to the health care system and unnecessary radiation exposure to the patient.[5–7]

This study was a collaboration between the orthopedic surgery departments of Zealand University Hospital and Odense University Hospital, DK.

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The purpose of this study was to evaluate how often radiographs taken at a 2-week outpatient visit result in a change in the standard postoperative regimen and treatment of the patient. Furthermore, we wanted to evaluate whether we should continue with this routine follow-up at the departments studied. We hypothesized that the radiographs would not result in changes in patient management.

Materials and Methods

This retrospective study included patients from two Danish hospitals, Zealand University Hospital (ZUH) and the University Hospital of Odense (OUH), with a catchment area of around 180,000 and 430,000 citizens, respectively. We performed a chart review of 613 patients with an operatively treated distal radius fracture who attended a clinical-radiological outpatient visit 2 weeks after their operation. Of the patients included in the study, 311 were treated at ZUH between January 1, 2009 and March 29, 2011. There were 302 patients treated at OUH between September 1, 2017 and December 31, 2018.

Patients who had undergone operatively treated distal radius fracture were identified through the internal hospital databases using the NOMESCO Classification of Surgical Procedure code KNCJ65.[8] This included patients with a distal radius fracture operatively treated with open reduction and internal fixation with a locking plate according to the AO principles of fracture management.[4] The standardized postoperative regimen at both hospitals includes a plaster cast of the operated extremity, followed by a scheduled outpatient visit approximately 2 weeks after surgery (10–14 days), which includes routine radiographs. At this outpatient visit, the plaster cast is replaced with a removable wrist splint for an additional 3 weeks and the patient is encouraged to begin unloaded home exercises. The removable wrist splint is discontinued at a final outpatient visit after 5 weeks and the patient is referred to a physiotherapist.

Medical, operative, and radiological records of the 613 patients included were reviewed.

A reporting form was developed in Epidata[9] to extract the following patient data: age, sex, fracture type (AO classification), type of volar plate used for internal fixation, loss of reduction of fracture on radiographs (dislocation of the fracture compared to postoperative radiographs), intra-articular joint penetration of osteosynthesis material on radiographs, reoperation, additional follow-up, prolonged immobilization (with a plaster cast or removable orthosis), and additional diagnostic imaging (including CT scans).

In some cases, a radiograph was not obtained before the 5-week follow-up. In those instances, these radiographs were used for evaluation (►**Fig. 1**).

Approval from our Institutional Review Board was obtained before beginning the study and the study was approved by the Danish Data Protection Agency (ref. 19/38050).

Results

A total of 641 patients were screened, of whom 613 patients were included in the study. The 28 patients not included were excluded due to loss of follow-up or because postoperative radiographs were not available. The mean patient age was 60 years (range 18–92 years) at OUH and 47 years (range 10–91 years) at ZUH. In the cohort studied, 78% were female and 22% male. Patient characteristics are presented in ►**Table 1**.

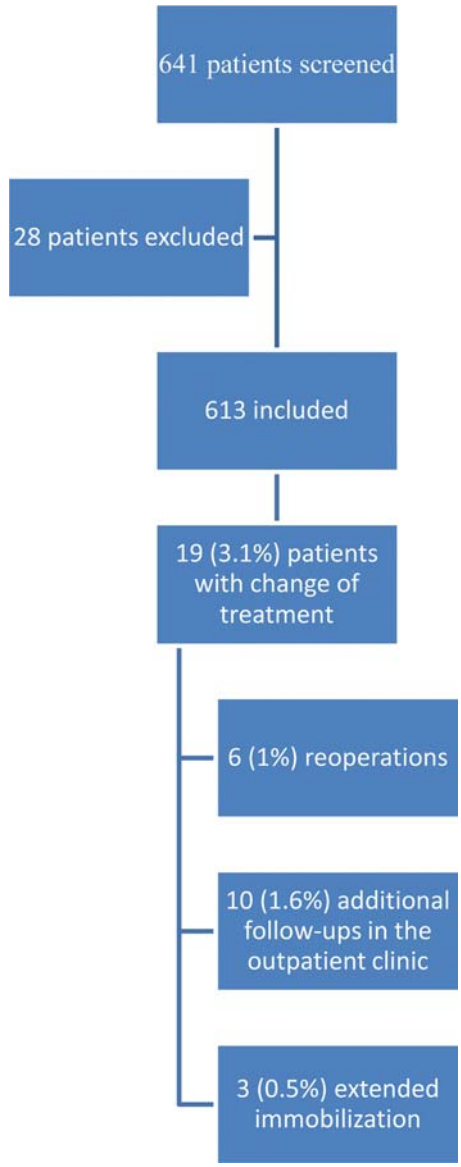

Fig. 1 Flow diagram of individuals at each stage of study.

Evaluation of the radiographs showed loss of fracture reduction in 1.3% of the cases. This led to a further operation of 1.0% of the cohort (plate removal or re-osteosynthesis).

The obtained radiographs resulted in a change of treatment for 3.1% of the patients: 1% of the patients underwent a second operation, 1.6% of the patients attended an additional follow-up at the outpatient clinic, and 0.5% of the patients were treated with various degrees of prolonged immobilization. Findings on the radiographs such as potential intra-articular joint penetration of a screw led to additional diagnostic imaging (CT scan) for 1.9% of the patients. None of the additional scans resulted in a change of treatment (►**Table 2**).

Table 1 Patient characteristics

	Odense University Hospital	Zealand University Hospital	Total	
Number of distal radius fractures	302	311	613	%
Patient				
Age	60 (range 18–91)	47 (range 10–91)		
Female	234 (77%)	247 (80%)	481	78%
AO classification				
23A1	1	0	1	0.2%
23A2	101	124	225	36.7%
23A3	30	85	115	18.8%
23B1	6	7	13	2.1%
23B2	12	5	17	2.8%
23B3	29	10	39	6.4%
23C1	54	45	99	16.2%
23C2	60	25	85	13.9%
23C3	9	4	13	2.1%
Unknown	0	4	4	0.7%
Type of volar plate				
Synthes variable angle LCP two-column plate	256	0	256	41.8%
Acumed	44	0	44	7.2%
Matrix Meditec	0	278	278	45.4%
Zimmer Biomet DVR	0	15	15	2.4%
Königsee	0	3	3	0.5%
Synthes T-plate	0	11	11	1.8%
Stryker Variax	0	4	4	0.7%
Unknown	2	0	2	0.3%

Abbreviations: AO, Arbeitsgemeinschaft für Osteosynthesefragen (AO Foundation); LCP, locking plate.

Table 2 Results of the obtained radiographs taken 2 weeks after surgery on distal forearm fractures

	Odense University Hospital	Zealand University Hospital	Total	
Number of patients screened	318	323	641	%
Patients excluded	16	12	28	
Patients included	302	311	613	
Change of treatment	8	11	19	3.1
Re-operation	5	1	6	1.0
Prolonged immobilization	1	2	3	0.5
Additional follow-up visit in the outpatient clinic	2	8	10	1.6
Further radiological evaluation (CT scan)	3	9	12	2.0
Loss of reduction	5	3	8	1.3

Abbreviation: CT, computed tomography.

Discussion

The present study aimed to assess the effect of radiographs taken at a 2-week outpatient visit in a large cohort of 613 patients with a distal radius fracture that had been surgically treated with a volar locking plate. Our results showed that these radiographs led to a change of the standardized regimen for 3.1% of the patients. Most of the changes to the follow-up regimen were simply additional follow-up visits (1.6% of the cohort). Only 1% of the patients required a second operation.

The strengths of this study included the low number of cases lost to follow-up, the large number of patients with distal radius fractures who both had a standardized method of treatment, and attended a follow-up. It was also beneficial

to have cases from two different institutions. A major limitation of the study was the retrospective design. Another major limitation of our study was that we did not record data relating to clinical findings, which probably has a significant influence on any decision to change the postoperative regimen.

Systematic reviews have found the overall incidence of surgical site complications associated with volar locking plates found at long-term follow-up to be 15 to 16.5%,[10,11] with 5% representing major complications that required a second operation.[10] These complication rates are somewhat higher than those identified in our study. However, we only reported complications that could be identified on X-rays 2 weeks following surgery (e.g., loss of reduction). Our findings showed a loss of reduction in 1.3% of the patients. This is comparable to the systematic review conducted by Bentohami et al, who found a corresponding 1% risk of loss of reduction of surgically treated distal radial fractures with a volar locking plate in adults, with a minimal 6-month follow-up.[10,11]

The 2-week visit to the outpatient clinic has several purposes, including the identification of any early complications. It is crucial to detect superficial infections early since they may develop into deep infections. As patients do not necessarily detect these infections themselves, we believe that it is important to maintain an organized clinical follow-up during the early postoperative period. Moreover, at the 2-week follow-up, other procedures are also performed, including removal of stitches or staples, replacement of the cast with a removable wrist splint, and the instigation of home exercises based on a home physiotherapy program. In conclusion, the continuation of 2-week outpatient visits is recommended, as there are multiple benefits to the patient.[12,13]

Our results found that the follow-up radiograph only resulted in a change of treatment for 3.1% of the patients. The question is whether this 3.1% justifies obtaining a radiograph as a standard procedure for all patients at the 2-week visit.

Plain radiographs of the wrist expose patients to an effective dose of radiation of around 0.001 mSv. According to the American College of Radiology, this dose is comparable to three hours of the background radiation to which we are all continuously exposed.[14] Therefore, the risk related to radiation is negligible and need not be a reason for concern to patients. Furthermore, the psychological benefits of referencing a radiograph for reassurance of the postoperative result might provide some relief of anxiety in patients and encourage them to intensify their rehabilitation exercises.

The price of plain radiographs of the wrist in Denmark is 68€, which is a fixed price in the Danish public health care system (tariffs for the year 2020).[15] We consider this an acceptable additional cost. In light of this, the low risk of radiation, and the benefits listed above, we decided to continue to take routine radiographs at 2-week outpatient visits to our two departments.

Conclusion

Radiographs were obtained in the outpatient clinic at 2-weeks follow-up after open reduction internal fixation of distal radius fractures. These led to a change of treatment for 3.1% of the patients, including 1.0% who underwent a second operation. Due to the low risk and low cost of plain radiographs, we will continue to obtain radiographs at 2-weeks follow-up in our departments.

Ethical Approval

The study was approved by the Danish Data Protection Agency. Ref. 19/38050.

Conflict of Interest

None declared.

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